Thermo Scientific Orion Ion Selective Electrode Theory

Measurements using an ion selective electrode (ISE) are applicable in virtually every laboratory. ISEs can be used to measure ion concentrations in water, food, pharmaceuticals and biological samples. Many analytical methods using ISEs have been developed and published worldwide. The main advantage of ion selective electrode technology is the variety of analytical methods that are available. Ion selective electrodes can be used as endpoint indicators or to perform direct measurements and incremental techniques.

Electrode measurements are simpler and faster than other analytical techniques. Time-consuming sample preparation steps such as filtration and distillations are rarely needed. Analysis time is typically under one minute. In comparison to methods such as atomic absorption or ion chromatography, the setup cost is less and does not require expensive equipment. Methods are adaptable to the lab or field. Sample color or turbidity does not affect the measurement. A variety of analytical techniques are available to the analyst.

Choosing the right measurement technique

	Within Linear Response Range	Within Non-Linear Response Range	Increased Precision	Occasional Sampling	Small Sample Volume	Large Number of Samples	Reduce Chemical Usage	Field Measurement	Ionic Strength > 0.1 M	Non-specific Ion Measurement
Direct Measurement	✓				✓	✓		✓		
Known Addition	✓			✓		✓	✓		✓	
Titration	✓		✓							
Low Level Measurement		✓				✓		✓		
Analate Subtraction				✓	✓	✓	✓		✓	
Indicator Titration										✓

Direct measurement is a simple procedure for measuring a large number of samples. Only one meter reading is required for each sample. Calibration is performed in a series of standards. The concentration of the samples is determined by comparison to the standards. Orion ISE meters calculate and store the calibration curves, saving you time in analysis and ensuring an accurate result. Ionic strength adjustor is added to all solutions to ensure that samples and standards have similar ionic strength, proper pH, and to reduce the effect of interfering ions.

Low level measurement is a similar method to direct measurement. This method is recommended when the expected sample concentration is within the non-liner response range of the electrode. A minimum 3 point calibration is recommended to compensate for the electrodes non-linear response at the concentrations. Calibration is performed in one beaker, reducing the chance of cross contamination of the solutions.

Known addition is a useful method for measuring samples, since calibration is not required. This method is recommended when measuring only a few samples, or when samples have a high (>0.1 M) ionic strength, or when there is complicated background matrix. The electrodes are immersed in the sample solution and an aliquot of standard solution, containing the measured species, is added tot he sample. The original sample concentration is determined from the changes in potential before and after the addition. As in direct calibration, any convenient concentration unit can be used. Many Orion ISE meters automate this measurement, by performing the additions and automatically calculating the result.

Analate subtraction is also a useful for method for measuring samples, since calibration is not required. The electrodes are immersed in a reagent solution that contains a species that the electrode senses, and that reacts with the sample. It is useful when sample size is small, for samples for which a stable standard is difficult to prepare, and for viscous or very concentrated samples. The method is not suited for very diluted samples. It is also necessary to know the stoichiometric ratio between standard and sample.

Titrations are quantitative analytical techniques for measuring the concentration of a species by incremental addition of a reagent (titrant)) that reacts with the sample species. Sensing electrodes can be used for determination of the titration end point. Ion selective electrodes are useful as end point detectors, because they are unaffected by sample color or turbidity.